# Habitat translocation and mineral workings

**John Box, Principal Environmental Scientist with Wardell Armstrong consultants, looks at the complex and often controversial technique of moving habitats.**

### Introduction

Minerals can only be extracted where they are found and certain minerals, such as ball and china clays, silica sand and magnesian limestone, are very restricted in their distribution. Habitat translocation has been used rescue wildlife habitats of nature conservation value from sites where mineral extraction or associated development such as tipping is proposed. Ecologists and conservationists have expressed concern that there are significant risks in habitat translocation and that these risks are not taken fully into account by those proposing developments that necessitate habitat translocation.

Moving a habitat from one site to another will result in changes to various physical and chemical factors which will lead to changes in the vegetation. The new location may have differences in its environmental context (slope, aspect, drainage) which may result in changes to the translocated vegetation. The translocation process itself will disturb the soil profile and cause changes in soil hydrology (for example, localised drying out of the soils) and soil chemistry (for example, an increase in the availability of soil nutrients due to mineralisation). The species composition of the vegetation will be affected by this 'transplant shock' and by the new environmental context.

Any assessment of success in any habitat translocation depends on two fundamental factors. Firstly, an objective and repeatable evaluation against the original aims of the project which should be capable of independent confirmation. Secondly, a decision as to whether sufficient time has elapsed after translocation for the results to be a valid indication that the vegetation has recovered from any short-term effects due to 'transplant shock'.

The aim of any habitat translocation needs to incorporate robust criteria against which success or failure can be measured in a reliable and repeatable way over a defined period of time:

- a receptor site with at least as large an area of the translocated habitat as the donor site;
- the retention of the same National Vegetation Classification (NVC) community type(s) and subtype(s) as the donor site;
- the retention of a nature conservation value at least equivalent to that of the donor site.

The inclusion of area in the criteria ensures that due attention is given to ensuring that the translocated vegetation maintains its diversity and quality across the whole of the receptor site. The reference to a defined period of time enables account to be taken of the short-term responses to translocation before a longer-term 'steady-state' is reached.

Both the National Vegetation Classification (NVC) community type and nature conservation value are integrative measures which are robust, widely used and well documented. The use of NVC community type allows for small changes to occur in the translocated vegetation due to the new environmental context which are within the context of the natural range of variation found within the described NVC communities.

The incorporation nature conservation value into the aims of a translocation project meets a key requirement for many people who want to be able to evaluate success or failure in terms of the nature conservation value of a site. A change in the ecology of a habitat does not necessarily result in a change in its nature conservation value. Nature conservation value is an integrative measure of quality that includes specific factors such as rare plants or animals as well as changes in habitat and species diversity. Nature conservation is also a material consideration in the development planning process (see PPG 9 'Nature Conservation').

*Green-winged orchid growing in translocated grassland at Brocks Farm*

Such criteria are technically demanding as they put a premium on getting the translocation right from the start in terms of the ecology in spite of the changes expected from 'transplant shock'. Furthermore, these criteria can be independently audited which is important if success and failure are to be adequately assessed.

### Critical success factors

There are three factors which are critical in minimising those environmental and biological pressures which might cause the vegetation type to remain the same but with a reduced nature conservation value, or cause the vegetation to change into another type which is of less value for nature conservation. These three critical success factors are: i) differences between the environmental context of receptor site and the donor site; ii) the habitat translocation technique; iii) the habitat management before and after translocation.

ENVIRONMENTAL CONTEXT. The receptor site should be very similar to the donor site in terms of aspect, slope, soil drainage, soil nutrient status and hydrology. Differences in the environmental context between the receptor and donor sites will influence the translocated vegetation. The degree of such influence needs to be minimized by careful selection of the receptor site, by creating an appropriate environmental context at the receptor site, and by maintaining comparable soil profiles and soil drainage conditions to those at the donor site.

### TRANSLOCATION TECHNIQUE.

Translocating grassland or heathland as turves is usually the preferred option for habitats of high nature conservation value because this method maintains the underlying soil profile and minimizes damage to individual plants and to the vegetation community.

Attention to detail during the planning and execution of the translocation is crucial to a successful outcome. An example of this would be moving the turves on the same day as they are cut without a period of storage which can cause drying out of the turves, loss of vegetation and mobilisation of soil nutrients.

Ideally, the turves need to be as large as possible and moved by specially adapted machines which can can move the turves with minimal disturbance. Practical considerations, such as the actual depth of the soil layer which contains roots, will influence the thickness of the turf which can be moved. A thick turf is likely to result in fewer changes to the soil profile than a thin one and the roots of deep-rooting plants may be cut off if a thin turf is used. Moving a layer of subsoil, as well as moving the topsoil and vegetation as a turf, may be a practical proposition and would help to maintain the general soil profile.

The turves should ideally to be laid in the same relative position and orientation in order to retain the patterns within a vegetation type which have developed in response to small variations in soil conditions. These patterns will be affected by the new environmental context of the receptor site. Double-handling will be required to achieve the same juxtaposition of turves but this may result in increased loss of soil which will have effects on the soil chemistry and the vegetation.

Best practice is achieved where the turves are laid tightly up against each other and immediately rolled to ensure good contact with the underlying soils/subsoils. Gaps and cracks must be filled with suitable soil to prevent air getting between the turves and causing desiccation and changes in the soil nutrients.

A very different technique involves the gross mechanical removal of the soil and the vegetation in a mixture which is spread or littered at the receptor site. The objective is to maintain the seedbank with propagules and root fragments for revegetation of the receptor site. This technique has been used for heathlands, grasslands and even woodlands after the trees have been felled. The gross disturbance to the soil and the soil profile due to this technique will undoubtedly influence the vegetation that develops due to changes in the physical, chemical and hydrological characteristics of the original soil layers. This technique is very different in approach to turf translocation and the results are much less predictable. Until there is more knowledge of the long-term results of this type of translocation compared to turf translocation, it would seem prudent to match the

**CASE STUDY**
**Brocks Farm (Devon)**

Species-rich hay-meadows with green-winged orchids were transplanted in 1988 by ECC International as both turves and litter to nearby receptor areas as part of the works associated with the extension of the spoil tip for the Newbridge open-cast ball clay pit near Newton Abbot in Devon.

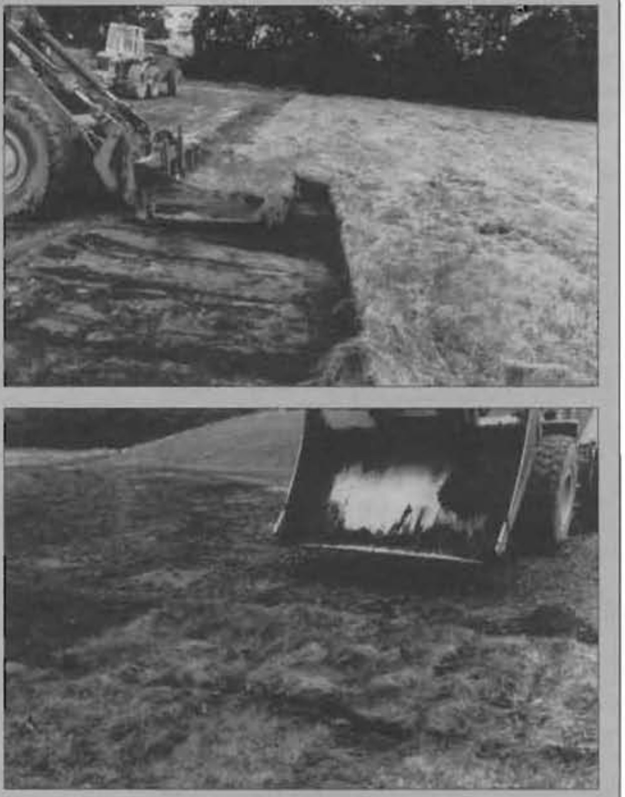
Topsoil and subsoil were stripped from the nearby receptor site which had a very similar environmental context to the donor site. Subsoil from the donor site was moved and spread on the receptor site in order to recreate similar ground conditions to the donor site. Approximately 0.4ha of vegetation was moved as turves (1.2m by 2.4m and up to 20cm thick). The remainder of the donor site (some 1.2ha) was flailed and the upper 50cm of topsoil and vegetation rotovated and spread evenly as a litter on to the littered receptor areas. The receptor sites have been regularly cut for hay every August since 1989; grazing by sheep was introduced following the hay-cut in 1992.

It is too early to draw definite conclusions about this translocation. Monitoring by Wardell Armstrong has shown that the grassland translocated as turves still conforms very well to the same NVC grassland community type as the donor site and has a high nature conservation value. However, monitoring by English Nature has demonstrated some changes in the species composition of the grassland and the botanical composition of the original grassland community has altered in its details. However, some changes in the botanical composition would be expected as a result of the translocation process and the new environmental context.

The vegetation of the littered receptor site has changed markedly from that of the donor field. Nevertheless, the littered receptor site is a most interesting example of habitat creation and might in time develop into a grassland which is floristically close to the original vegetation of the donor site. A large population of green-winged orchids has developed on the littered receptor site (6,800 flowering spikes were counted in 1996, 3,500 in 1997, and 8,000 in 1998).

The nature conservation value of the translocated grasslands was recognised in 1995 by the Devon Wildlife Trust who included both the translocated turf and much of the littered area in a County Wildlife Site in 1995.

❑ See also **Mineral Planning Appeals in Great Britain 1998** (p.50) for coverage of an appeal involving translocation at the Brocks Farm site.



*Lifting turves at Brocks Farm in Devon (top) and laying turves at the receptor site (bottom).*

technique to the nature conservation value of the habitat such that mass movement of soils and littering are used for habitats of low nature conservation value.

HABITAT MANAGEMENT. The lack of appropriate habitat management can have a devastating effect on habitats that are maintained by grazing or mowing, such as grasslands or heathlands. For example, grasslands of importance for nature conservation generally have a dominance of plant species adapted to the particular grazing or hay-making regime. Cessation of grazing or hay-cutting removes one of the fundamental constraints on the ecosystem and the species composition will move towards coarse grasses and eventually scrub at the expense of fine-leaved grasses and herbs such as orchids. The appropriate management of wetland and woodland habitats is important, particularly after a disruptive process such as translocation.

**Conclusions**

Habitat translocation is a recognised technique, albeit in its infancy, which is of significance because it potentially allows habitats to be conserved as a mitigation exercise in advance of mineral extraction for which there is no alternative location. Habitat translocation is no substitute for in situ conservation and will not achieve the precise preservation of a habitat as there will be some changes in the vegetation. But translocation can be used to create habitats which closely resemble the original as an alternative to their total loss. The technique should be used in special cases where there are strategically important minerals in localised situations and the importance of the mineral can be equated with the nature conservation value of the habitat to be translocated.

Disturbances associated with translocation ('transplant shock') will cause changes to the vegetation community over the short-term (up to 10 years). In the longer-term, the translocated vegetation community will reflect differences due to the new environmental context. The ideal situation is one where disturbances due to the translocation process and to the new environmental context are small, and do not lead to significant changes in the composition of the vegetation, so that its nature conservation value (or quality) is maintained. Appropriate habitat management techniques can be used as a powerful force to maintain the original vegetation type as long as there are no significant long-term changes due to the physical and chemical factors of the new location.

The ground conditions and the subsequent habitat management regime were given proper consideration prior to translocation in the case studies at Brock's Farm and Thrislington Plantation. As a result, the translocated vegetation in both cases is very similar to the original donor vegetation. The wet heath translocated to the experimental cell at Gadle Knapp has become more diverse than the vegetation originally

**CASE STUDY**
**Gadle Knapp (Dorset)**

The mining operations in the ball clay area of the Bovey Basin, near Wareham, take place in areas of great sensitivity because the ball clay deposits lie underneath lowland heathland much of which is covered by international nature conservation designations. To investigate the feasibility of rescuing threatened heathland areas, ECC International decided to translocate a small, isolated area of wet heath which would have been lost due to the extension of their open-cast ball clay workings at Dorey's Farm in 1993. This demonstration scheme was discussed with and approved by Dorset County Council, English Nature and the Dorset Wildlife Trust.

The wet heath covered about 1,000m$^2$ and comprised purple moor-grass, cross-leaved heath and bogmosses in transition towards a drier type of heath with large patches dominated by bog myrtle. The depth of peat varied between 12 and 18 cm. Nearby boreholes indicated that the water-table varied seasonally between ground level and 0.5m depth and the soils were permeable fine sands. The wetness was clearly due to groundwater rather than impeded surface drainage.

An experimental clay cell was constructed at the receptor site at Gadle Knapp in 1993 in conjunction with an artificial groundwater-dominated hydrological regime fed by springs and an outflow controlled by a weir. The experimental cell consists of an excavated rectangular hollow with a level top and a sloping base formed from compacted clay using simple earthmoving machinery.

The wet heath at the donor site was marked out into 2m x 1m turves which were lifted in October 1993 using a specially designed front-end spade on a tractor and the turves were transported by trailer to the receptor site.

The vegetation and the water levels of the receptor site at Gadle Knapp have been regularly monitored. The original wet heath was becoming drier and decreasing in its nature conservation value. High water levels have been maintained in the experimental cell and the translocated vegetation has remained wet throughout the summer periods. The vegetation has already responded to the new hydrological regime and clearly shows an increase in the abundance of bogmoss and wet heath species and a decline in species preferring drier conditions. The vegetation appears to be developing into a vegetation type which is of greater nature conservation value than that at the original site.

*Laying turves of wet heath at the receptor site at Gadle Knapp in Dorset* present at the donor site and has a high nature conservation value.

Translocation does not necessarily result in fundamental changes to the ecological characteristics and nature conservation value of a habitat provided that the translocation technique is of a high standard and the environmental context and the management regime are maintained as constant factors. The standards for applying these critical success factors need to be matched to the particular objectives of a translocation project in order to reduce the risks to a level compatible with the nature conservation value of the translocated habitat.

A framework for habitat translocation is required which provides a set of agreed standards involving the regulators (the local planning authorities and the statutory nature conservation agencies) and representatives of business and industry who have practical experience of habitat translocation. The pressure to adhere to these standards and to adopt best working practices would come from the planning authorities who need to find effective mechanisms for ensuring that habitat management and monitoring schemes are fully implemented. Such a framework would also enable decisions to be taken on planning applications which take account of the input by a developer before, during and after a proposed habitat translocation. This would allow the highest standards to be applied in an emerging discipline which combines the scientific aspects of ecology with engineering expertise in respect of site design and translocation techniques.

### CASE STUDY
### Thrislington Plantation SSSI (Durham)

*Lifting a large turf at Thrislington Plantation (top) and a grassland turf at the receptor site six months after translocation showing perimeter infill and rockrose in flower (bottom).*

The donor site comprised limestone grasslands of high nature conservation value lying over high quality magnesian limestone. The grassland was was translocated as turves (4.75m by 1.75m and 45-50cm thick) using a front-bucket offloader between October and March each year from 1982 to 1990 to a nearby receptor site which was very similar in terms of drainage and topography. Blocks of turves, normally supporting the same type of vegetation, were not always laid in the correct juxtaposition from donor site to receptor site, but turves within blocks were relaid at the receptor site in the same relative position as they were in at the donor site. In total, some 5.5ha of grassland were translocated to the receptor site by 1990.

Grazing of the whole site ceased around 1965 and scrub invasion was occurring throughout the SSSI prior to translocation. After an initial two years without management, the translocated grasslands were cut annually with a flail mower. Sheep grazing from September to May was reintroduced in 1992 to the whole of the SSSI including the receptor site.

The SSSI was extended in 1984 to include the receptor site and the whole site was renotified as SSSI in 1997. Furthermore, the SSSI was declared a National Nature Reserve in 1992 and is currently proposed as a Special Area for Conservation under the EC Habitats & Species Directive. Based on a site visit in July 1996 and discussions with David Park, the ecologist employed by the owners Lafarge Redland Aggregates, the translocated grasslands have maintained the original NVC community types. This translocation can be judged to be a success as its nature conservation value, as well as the original NVC communities, have been maintained.

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# Quarry conflicts

In April CPRE's new publication 'Quarry Conflicts', launched to raise awareness of the damaging effects of quarrying, lived up to its name as the Quarry Products Association accused CPRE of being *"rooted in the past"*. As part of the campaign to improve minerals planning, CPRE aims to highlight the loss that the countryside is suffering from quarrying; various literary links are chosen to assist (eg *"the threat from permissions to quarry close to the Pilgrim's Way, featured in Chaucer's Canterbury Tales"*). The main argument however is, with the impending review of MPG6, to avoid the 'predict and provide' approach to minerals planning.

CPRE suggest that demand forecasts should inform the minerals planning system alongside environmental constraints which should influence the overall rate of extraction. As the demand for minerals is currently falling, local authorities should plan for a reduced level of quarrying; and local authorities should be released from the need to pay compensation when they need to revoke environmentally damaging permissions. There should be guidance on end use control, demanding targets for the use of recycled materials, and reduced landbanks for all aggregates of five years.

Invoking Wordsworth, Chaucer, and Betjeman, CPRE argued that *"minerals planning policy risks being stuck in a time warp"*. The QPA found this a fairly easy target: *"It is disappointing that CPRE campaign against quarrying remains so rooted in the past when the quarrying industry is moving with the times"* said the QPA Director General, Simon van der Byl.

Examples of damaging quarrying activity in the countryside quoted by CPRE are Wattscliffe gritstone quarry on Harthill Moor in the Peak Park, limestone quarrying near Birchover and Matlock in the Peak Park; dormant gritstone quarries of Lees Cross and Endcliffe in the Peak District (see Agenda in this issue); limestone quarrying at Ashton Court Country Park, near Bristol; a sandstone permission at Bestwood Country Park near Nottingham; a ragstone quarry at Blaise Farm, Offham, Kent; the Upper Thames Valley in Wiltshire; and possible quarrying at Down Ampney in Gloucestershire.

'Quarry Conflicts' is available for £2.50 from: CPRE, Warwick House, 25 Buckingham Palace Road, London SW1W 0PP.

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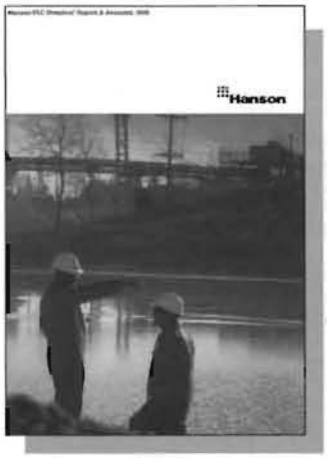
***Moving habitats:*** *Lifting a turf at Thrislington Plantation SSSI in Durham (above); translocation of habitats is the subject of an article in this issue on page 11. Moving habitats threatened by quarrying has featured in previous issues of* ***Mineral Planning****; at Thrislington the first turf was moved in 1982, and developments were reported in* ***Mineral Planning 19*** *&* ***33*** *in 1984 and 1987.*

## QPA 'New Deal'

In May the Quarry Products Association put forward an improved 'New Deal' package as an alternative to potential aggregates taxation.

It proposes that *"the practice of assuming ever increasing levels of demand for aggregates is ended"*. The revised MPG6 should be *"based upon the assumption that aggregate demand over the next five years remains relatively flat"*. For a longer term trend, Government should extend this assumption of flat demand and then review the outlook regularly. Planning policy should seek the optimum use of recycled materials, with the supply of primary aggregates to make up the balance of demand not met by recycled materials.

While there will be a continuing need for aggregates, the QPA considered that supply sources should reflect the best environmental balance, including the need to minimise the need for long distance road haulage, and the principle of supplying UK markets from UK aggregates sources should be maintained. (see also pages 14 & 15)



*"Go and do better ...."*
Has quarrying been shown the yellow card?

## Slate quarry call-in

A proposal to extend working at Bursting Stone slate quarry in the Lake District National Park was called in by the Secretary of State in May.

The Council for National Parks welcomed the call-in, which followed the Lake District National Park Authority's decision to grant permission for the extension. A Public Inquiry is likely to be held. Bursting Stone slate quarry is on the prominent south ridge of Coniston Old Man and is responsible for waste on the fellside which can be seen from a great distance.

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# In Reply

*Letters for publication in **Mineral Planning** are always welcomed.*

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Dear Milford and Steve

**Habitat Translocation**

I was quite interested to read, in **Mineral Planning 79**, the article by John Box on the topic of habitat translocation.

I was quietly amused to read the suggestion that this technique was in its infancy. Translocation of overburden was adopted at the Lochhouses Links beach sand extraction site round about 1973 - 1974. The site is within what is now the John Muir Country Park a short way north of the mouth of the River Tyne in East Lothian.

Turf material was lifted in large sections by a wheeled loader shovel and replaced once the material had been dug away from the rear of the dune feature which contained the sand. Maybe the site would provide some information on the longer term effects of translocation of overburden.

The contractor who undertook the work was, I think, the Musselburgh based B M Mullen and I think they are still in business. They may have someone who can recall this operation and be able to provide details.

It all goes to prove there is nothing new under the sun and that time really flies. It hardly seems like yesterday since we were all enthused by **Mineral Planning 1**.

Kind Regards
Jim Henry
Edinburgh

Dear Sir

**Habitat translocation**

We read with great interest the article by John Box in **Mineral Planning 79** (p.11). We would agree with Dr Box that translocation of heathland soil and vegetation is likely to be most effective if this is moved as intact turves, in order to avoid mixing the horizons of the upper soil profile, but this is less important for brown earths, the upper horizons of which are mixed naturally by earthworms.

The article quotes a case study at Brocks Farm, where on part of the area turves were removed, up to 20cm thick, whereas on another part the ground was rotovated to a depth of 50cm (it seems likely that this was a typing error for 50mm) and moved as a "litter". If the upper soil horizon had a depth of 20cm, then why was only the upper 50mm (or possibly as much as 50cm) transferred? It appears that the operation has been seen primarily as a botanical exercise, rather than an exercise in soil transference. If only 50mm of topsoil was moved in the second part of this scheme then one could not expect it to be similar to the original soil which we assume had 20cm of topsoil (and the same would apply if 50cm was moved).

Movement of the complete topsoil (typically between 20 and 30cm under grassland), as soil but without rotovation, allows some of the deeper rooted plant species to be transferred intact, and a proportion of these are likely to survive the transfer. (Rotovation would chop the roots of such plants into small fragments, as well as destroying some of the soil structure.) In addition, the original soil profile, which in the long term is the most crucial factor, will soon be recreated. Movement in this way, by loose-tipping onto a prepared base, allows adequate care to be given to the condition of the subsoil (either moved or in situ) without the risk of turf-moving vehicles causing compaction by travelling over the subsoil after it has been prepared to receive the topsoil. While compaction created during dry weather may be removable prior to placing turves, this will probably not be possible under wet conditions.

If these operations can be timed appropriately, normally between September and November, the soil and vegetation will have time to settle before the start of the next growing season.

Dr Box claims that movement of soil and vegetation in a mixture will result in changes in the physical, chemical, and hydrological characteristics of the soil and that the results are much less predictable than when intact turves are transferred. From our experience, on several sites over the last 20 years, we would disagree with that statement. We have seen turf-moving elsewhere which looked fine after 6 months but after 6 years bore little resemblance to the original vegetation, whereas soil moving exercises, correctly undertaken, have given very good results over this length of time, provided that the receptor site is comparable with the characteristics of the donor site.

We therefore disagree with the statement that turf transference is necessarily the better method. This would apply particularly to woodland soils, where there is usually no 'turf' which could be transferred in any event.

Where compaction of the subsoil is not a problem (as, for different reasons, in the examples quoted by Dr Box at Gadle Knapp and Thrislington), then moving vegetation as turf may be as good as, or even better than, moving it as soil and vegetation; although the operation is likely to be slower (which is sometimes a crucial factor, if the operation is to be carried out at the best time of year) as well as being more expensive.

The methodology which we have used (Helliwell, D R 1996: 'Case studies in vegetation change, habitat transference, and habitat creation') allows movement of soil and vegetation to be carried out without being held up unduly by weather conditions (other than snow) and without undue harm to the soil profile.

Therefore, while we agree with much of what Dr Box says, we consider that he dismisses too readily what, to us, appears to be the approach which is most sensible in many circumstances.

Yours etc
S J Fordham, D R Helliwell,
and T R Worthington.
Reading Agricultural Consultants,
Didcot.

● *John Box responds:*

There was an unfortunate error in the Brocks Farm case-study which indicated that 50cm of topsoil was moved as a litter of vegetation and topsoil from one part of the site rather than the 50mm which was in fact moved. The turves which were moved from another part of the site were indeed up to 20cm thick.

Habitat translocation is a recognised technique, albeit in its infancy, which is of significance because it has the potential to allow habitats to be conserved as a mitigation exercise in advance of mineral extraction for which there is no alternative location. Ecological knowledge has to be married with engineering expertise in respect of site design and techniques. Unfortunately, there is a dearth of good scientific evaluations of habitat translocations and a lack of detailed monitoring which would allow effective comparisons to be made between different translocation techniques.

There is a need for the regulators (the planning authorities and the statutory nature conservation agencies) and representatives of business and industry with relevant experience to agree a framework for habitat translocation which would start to allow the most appropriate technique to be applied to each site.